Plutonium Contamination of the Environment: What's the Problem?

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It is estimated that, since the dawn of the nuclear era, the inventory of plutonium on earth has increased from ~2 kg to 2,630,000 kg. This inventory is increasing annually by approximately 70,000 kg as a result of nuclear power generation. Approximately 1% of the total global inventory has been released into the environment. The releases have come from various sources: nuclear weapons tests, accidental releases from nuclear installations, accidents with vehicles carrying nuclear materials (satellites, aircraft), effluents from reprocessing facilities and poorly managed disposal and dumping of radioactive wastes. The fate of plutonium in the environment, its transfer to the food chain, and risk to humankind and the environment depends on the nature of the released plutonium, the biogeochemical processes controlling its mobilization, and the eventual exposure pathways.

Surface and subsurface transport of low levels of Pu from environmental releases worldwide has been documented on the scale of kilometers [1, 2]. While the concentrations are typically low, the real and perceived risk to human health and the environment demands our attention. The particularly high toxicity and long half-life of Pu isotopes requires understanding and predicting their behavior over exceedingly long timescales (tens of thousands of years). From the standpoint of long-term isolation/storage of high level nuclear waste, the risk of Pu and the other actinides (e.g. U, Np) will likely need to be assessed at even longer timescales (hundreds of thousands of years). Transformative science and technology solutions to address this environmental challenge and the challenges associated with energy production, nuclear security, and waste management are needed. We have entered an era in human history in which actinides will be present in our environment for the foreseeable future; their impact both locally and globally must be understood.

[1] Kersting et al. (1999) *Nature* **397,** 56-59. [2] Novikov et al. (2006) *Science* **314,** 638-641.